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THE BRAIN OF THE SWORDFISH (*XIPHIAS GLADIUS*)

By G. Miles Conrad

The swordfish brains used in this study were collected by the Lerner Cape Breton Expedition of The American Museum of Natural History at Louisburg, Nova Scotia. In a fish of the average length of eleven feet from the tip of the sword to the notch of the caudal fin the brain would measure about 1 5/16 inches in length and 7/8 inch wide across the optic lobes.

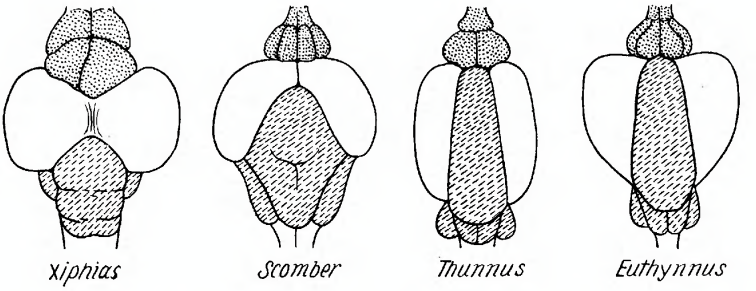

Fig. 1. Comparative series of scombriform brains, showing the relative sizes of the cerebellum (oblique broken lines) and the forebrain (stippled) in *Xiphias, Scomber, Thunnus* and *Euthynnus*. *Scomber, Thunnus* and *Euthynnus* are redrawn from Kishinouye.

In keeping with the evolutionary tree of the scombriform fishes as proposed by Gregory (1933, p. 318, Pl. 1), it may be noted that the brain of *Xiphias* compares more favorably with that of *Scomber* than with that of *Thunnus* or its allies.

A dorsal view of the brain of *Xiphias* (Fig. 2A) shows an almost typical teleost brain. The cerebellum is of an "oblong" form extending from the medulla oblongata over about one-third of the optic lobes. As in the tuna and the mackerel the surface of the cerebellum is grooved. The scombriform brains figured by Kishinouye show in almost every case the cerebellum reaching from the medulla to the forebrain. In *Thunnus germo* the length of the cerebellum is 73 per cent of the whole; in *Scomber*, 57 per cent; and in *Xiphias* it is 38 per cent (Fig. 1).

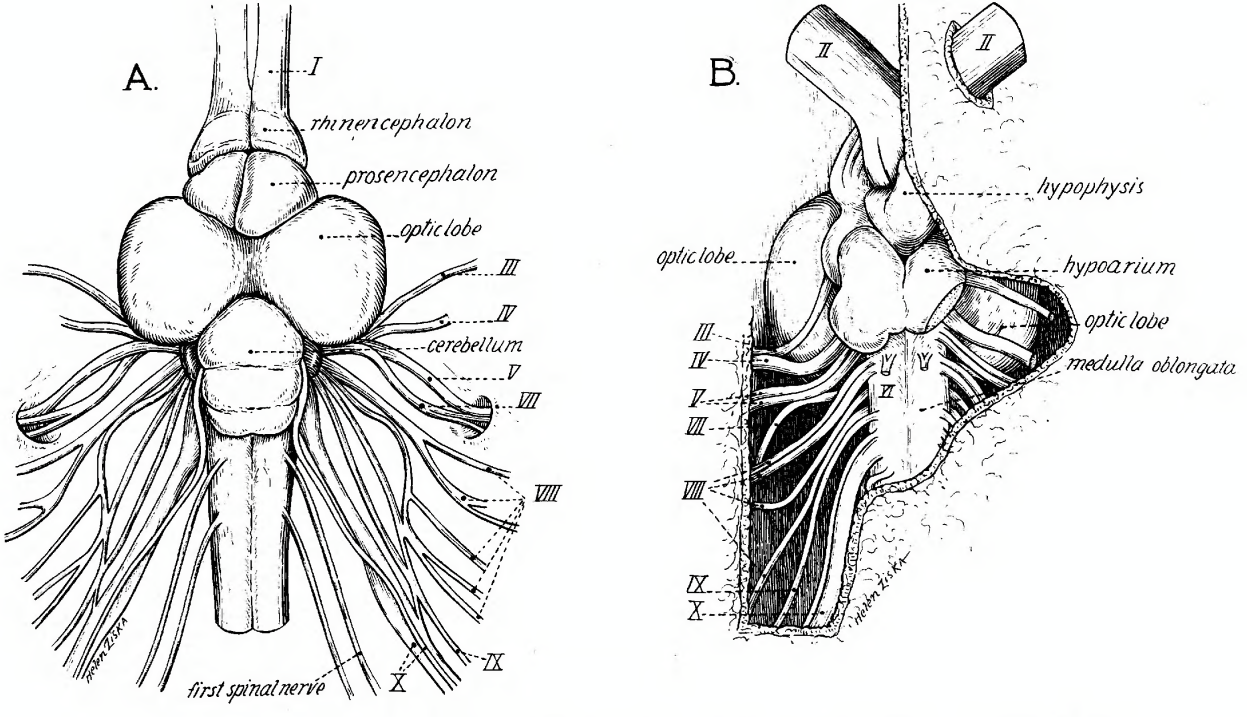

Fig. 2A. Dorsal view of the brain of *Xiphias*. 2B. Ventral view of the brain of *Xiphias*.

The optic lobes, while well developed, are not exceptional when compared with other scombriform brains. The pineal body, or epiphysis, is apparently absent or greatly reduced. Many figured brains of teleosts, including those of Kishinouye in his study of the scombroid fishes, appear to lack this element, so that its absence or reduction in *Xiphias* is not unusual.

The forebrain is relatively large and, judging from Kishinouye's figures (1923, p. 352), is very large for the group. It constitutes about 35 per cent of the length and 51 per cent of the greatest width of the entire brain in *Xiphias;* in *Scomber* the proportions are: length, 25 per cent, width, 46 per cent; in *Thunnus germo*, length, 20 per cent, width, 43 per cent; and in *Euthynnus yaito* the length is 25 per cent and the width is 38 per cent of the whole (Fig. 1). This large size suggests a superior olfactory sense.

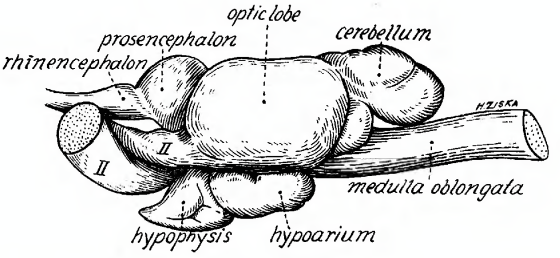

Fig. 3. Lateral view of the brain of *Xiphias* with the cranial nerves removed.

The most noticeable difference between the brain of *Xiphias* and that of the tuna, as figured by Kishinouye, is the relatively small cerebellum of the former. That the size of the cerebellum is correlated with the muscular activity of the animal seems borne out by this, for the tuna is a very active fish at all times, while the swordfish often floats sluggishly about near the surface and does not seem capable of prolonged action. The mackerel, whose cerebellum is somewhat larger than that of *Xiphias*, approaches the tuna in activity.

The ventral aspect of the brain (Fig. 2B) is notable for its prominent inferior lobes, or hypoaria, and for the large hypophysis. The pituitary body in *Xiphias* forms a triangular wedge, which forces its way between the anterior ends of the hypoaria. Ventrally the hypophysis tapers to a conical apex (Fig. 3), as contrasted with its almost spherical contour in

Scomber as figured by Allis (1903, Pl. XII). As in the mackerel no saccus vasculosus was found.

The cranial nerves seem to be easily homologized with those of the typical teleost complex.

REFERENCES TO LITERATURE

ALLIS, E. P. 1903. 'The skull and the cranial and first spinal muscles and nerves in *Scomber scomber*.' Jour. Morph., XVIII, No. 2, pp. 45–328.

GREGORY, WILLIAM K. 1933. 'Fish skulls: a study of the evolution of natural mechanisms.' Trans. Amer. Philos. Soc., N.S., XXIII, No. 2, pp. 75–481.

HERRICK, C. J. 1899. 'The cranial and first spinal nerves of *Menidia;* a contribution upon the nerve components of the bony fishes.' Jour. Comp. Neur., IX, Nos. 3, 4, pp. 153–455.

KISHINOUYE, K. 1923. 'Contributions to the comparative study of the so-called scombroid fishes.' Jour. Coll. Agriculture, Imp. Univ. Tokyo, VIII, No. 3, pp. 293–475.

MEADER, R. G. 1934. 'The optic system of the teleost, *Holocentrus*. 1. The primary optic pathways and the corpus geniculatum complex.' Jour. Comp. Neur., LX, No. 3, pp. 361–407.

OWEN, R. 1866. 'Anatomy of Vertebrates. Vol. I, Fishes and Reptiles.' London. 1866.